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EL ELEMENT
[EL SOSHI]

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Specification

1. Title of the Invention

EL Element

2. Scope of Patent Claims

An EL element, wherein a mixture of a fluorescent material, which emits lights with a blue green color, and Rhodamine 3GG is included as a light-emitting material in a luminous layer.

3. Detailed Description of the Invention

(Industrial application field)

The present invention pertains to an EL element that emits lights with a white color.

(Prior art and its problems)

EL devices having an EL element, which emits lights with a white color, have frequently been used as a surface light source, et cetera; however, the element itself is not a fluorescent material that emits lights with a white

[1] Numbers in the margin indicate pagination in the foreign text.

color. For this reason, as light-emitting materials of the EL element, mixtures of various kinds of fluorescent materials and fluorescent dyes are used.

As these mixtures, a mixture of fluorescent materials of ZnS:CuCl (ZnS to which Cu and Cl are added as activators; hereinafter similarly applied) for emitting light with a blue green color and ZnS:CuMn for emitting light with a brown color, a mixture of ZnS:CuBr as a fluorescent material for emitting light with a green color, and Rhodamine B as a fluorescent dye for emitting light with a red color, et cetera are known.

However, when different kinds of fluorescent materials are mixed, the hue of light is changed with the lapse of time because of the life difference of each fluorescent material, and the luminance is also low. On the other hand, when ZnS:CuBr and Rhodamine B are mixed, only light with a yellowish white color instead of a white color with high purity can be obtained, and the luminance is also low.

(Purpose of the invention)

The present invention considers the aforementioned problems, and its purpose is to provide an EL element that can obtain a white light with good color purity and high luminance, regardless of a lapse of time.

(Outline of the invention)

The present invention pertains to an EL element in which a mixture of a fluorescent material, which emits light with a blue green color, and Rhodamine 3GG is included as a light-emitting material in a luminous layer.

(Application example)

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Next, an application example of the present invention will be explained with reference to Figures 1 through 4.

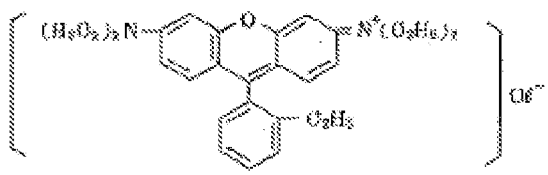
Figure 1 shows a flexible EL device using an EL element of the present invention. In this flexible EL device (1), an EL element (2) as a thin plate with an approximately square shape is sealed between two sheets of transparent moisture-proof films (3) with an approximately square shape with an area larger than that of the EL element (2), and the entire EL device (1) has flexibility.

The EL element (2) has a transparent electrode (5) composed of ITO vapor-deposited under vacuum on a transparent polyester film (4). On the transparent electrode (5), a slurry-state luminous layer (6) is spread at a thickness of 50 µm by a screen printing, and the luminous layer (6) is dried by holding at 150° C for 3 min. An Al foil is thermocompression-bonded at a thickness of 100 µm on the luminous layer (6) by a heat roll at 180° C,

and the Al foil acts as a back face electrode (7) of the EL element (2).

As the material of the luminous layer (6), a material in which a mixture of ZnS:CuCl (50 to 95 wt %) and Rhodamine 3GG (0.01 to 0.1 wt %) is dispersed into a binder (50 to 5 wt %) with high dielectric constant is used.

Rhodamine 3GG, as is shown by the following molecular formula,



is a basic dye in which a carboxyl group of Rhodamine B is changed to propyl ester, and this dye is excited by light with a wavelength in the vicinity of 5,000 Å, emitting fluorescent light with a strong orange color. The aforementioned binder with a high dielectric constant is composed of trifluoroethylene-polyvinylidene fluoride, cyanoethyl cellulose, et cetera. In addition, an appropriate amount of dimethylacetamide may be included as a solvent for adjusting the viscosity in the luminous layer (6). Moreover, the amount of addition of Cu and Cl in ZnS:CuCl is 0.045 wt % and 0.020 wt %, respectively.

Two sheets of moisture-proof films (3) are thermocompression-bonded to each other at the periphery of

the EL element (2) so that the EL element (2) is sandwiched from both sides by two electrodes (5) and (7). Since this thermocompression bonding is carried out in a dried Ar or N_2 gas, the dried Ar or N_2 gas is sealed in a gap (8) between two sheets of moisture-proof films (3) and the EL element (2). As the moisture-proof film (3), fluorocarbon film (for example, Acura made by US Allied Chemical Co.), polychlorotrifluoroethylene film, et cetera are used.

On the electrodes (5) and (7), for the connection to an external power source (not shown in the figure), terminals (not shown in the figure) of leads (not shown in the figure) are pasted, and these leads are extended to the outside from two sheets of moisture-proof films (3).

If an alternating-current voltage is applied via the leads (not shown in the figure) to the electrodes (5) and (7) of the EL device (1) with the above constitution, the luminous layer (6) emits a light. This light is drawn out through the transparent electrode (5), transparent polyester film (4), and transparent moisture-proof film (3), and the EL device (1) is used as a surface light source.

Figure 2 shows the relationship between the wavelength of the light obtained by the EL device (1) and the relative energy. As is seen from Figure 2, the light of the EL

device (1) has two peaks of the relative energy at a wavelength in the vicinity of 4,700 Å and 5,700 Å. The former is a blue green light from ZnS:CuCl, and the latter is an orange light from Rhodamine 3GG.

Figure 3 is an xy chromaticity diagram showing chromaticity points of the light shown in Figure 2. The chromaticity points of the light shown in Figure 2 are x = 0.3486 and y = 0.3620 and are a white color with very good purity as is shown by point x in Figure 3.

In addition, Rhodamine 3GG is excited by light with a wavelength in the vicinity of 5,000 Å and emits a fluorescent light, and as is seen from Figure 2, and a blue green light of ZnS:CuCl has a relatively high relative energy at a wavelength in the vicinity of 5,000 Å. As a result, it is understood that Rhodamine 3GG is effectively excited by a blue green light of ZnS:CuCl and emits a light with a high relative energy.

Figure 4 shows the luminance of each light of an EL device in which a light-emitting material is a mixture of

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fluorescent materials of ZnS:CuCl and ZnS:CuMn and the EL device (1) of this application example. Figure 4 shows the result of a case in which the voltage of an alternating-current power supply with a frequency of 1 KHz is changed

to various values. In Figure 4, the alternate long and short dash line indicates the EL device using a mixture of ZnS:CuCl and ZnS:CuMn, and the solid line indicates the EL device (1) of this application example 1. As is mentioned above, since Rhodamine 3GG is effectively excited by a blue green light of ZnS:CuCl and strongly emits a fluorescent light, as is seen from Figure 4, the EL device (1) of this application example can obtain light with a high luminance, even at a low voltage.

(Working example)

In the above, the present invention has been explained based on an application example; however, the present invention is not limited to this application example and can be variously modified.

For example, in the aforementioned application example, ZnS:CuCl has been used as a fluorescent material to be mixed with Rhodamine 3GG; however, any fluorescent materials that emit light with a blue green color other than ZnS:CuCl may also be used.

In addition, in this aforementioned application example, the present invention has been applied to the flexible EL device (1); however, the present invention can also be applied to EL devices other than the flexible type.

Moreover, in the aforementioned application example, the EL device (2) to which the present invention is applied is an EL device in which only one electrode (5) is a transparent single-faced light emission; however, the present invention can also be applied to an EL device of a double-faced light emission in which two electrodes are transparent.

(Effects of the invention)

As is mentioned above, according to the EL element of the present invention, a mixture of a fluorescent material, which emits light with a blue green color, and Rhodamine 3GG is included as a light-emitting material in a luminous layer.

Therefore, since different kinds of fluorescent materials with a life difference are mixed, white lights with good color purity can be obtained, regardless of a lapse of time.

In addition, since Rhodamine 3GG is excited by blue green light and strongly emits fluorescent light with an orange color, white light with a high luminance can be obtained even at a low voltage.

4. Brief Description of the Figures

Figure 1 is an outlined cross section showing a flexible EL device using the EL element of the present invention. Figure 2 is a graph showing the relationship between the wavelength of a light by the EL device shown in Figure 1 and the relative energy. Figure 3 is a graph showing xy chromaticity points of the light shown in Figure 2. Figure 4 is a graph showing the luminance of each light of a conventional EL device and the EL device shown in Figure 1.

Here, in the numerals that are used in the figures, (2) is an EL element, (5) is a transparent electrode, (6) is a luminous layer, and (7) is a back face electrode.

Figure 1:

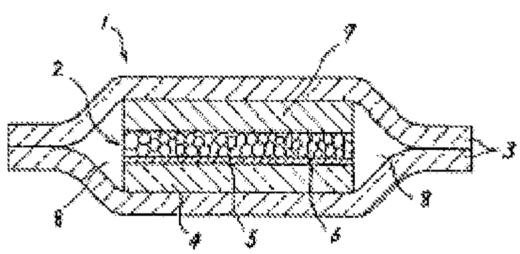
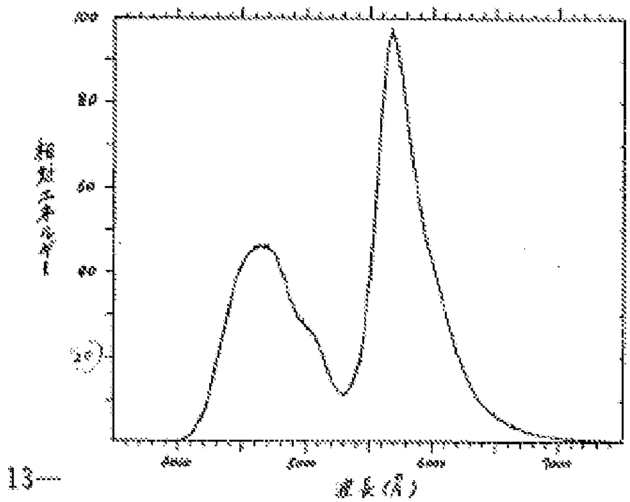


Figure 2:



[Y Axis]: Relative energy

[X Axis]: Wavelength (Å)

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Figure 3:

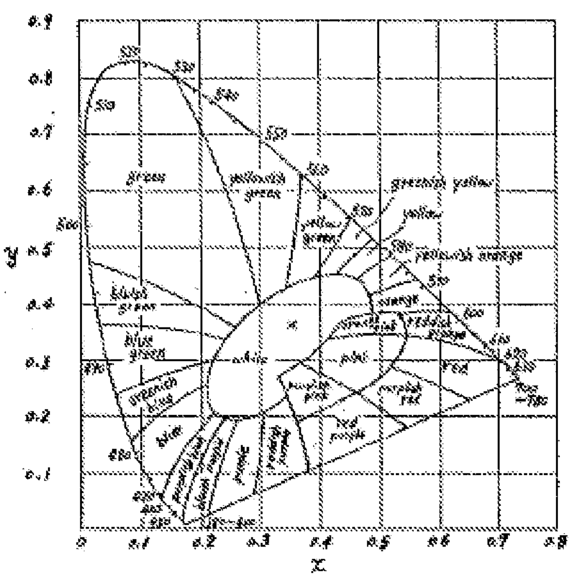
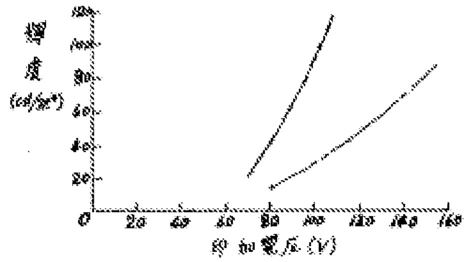


Figure 4:



[Y Axis]: Luminance (cm^2/m^2)

[X Axis]: Applied voltage (V)